WHAT IS CLAIMED IS:

1. A method for depositing a layer on a substrate in a process chamber, the method comprising:

supplying a gaseous mixture to the process chamber, the gaseous mixture comprising a silicon-containing gas, a fluorine-containing gas, an oxygen-containing gas, and a nitrogen-containing gas;

providing energy to the gaseous mixture to deposit a nitrogen-containing fluorinated silicate glass layer onto the substrate.

2. The method of claim 1 further comprising forming a barrier layer over the nitrogen-containing fluorinated silicate glass layer.

3. The method of claim 2 further comprising forming a metal layer over the barrier layer.

4. The method of claim 3 wherein the metal layer comprises copper.

5. The method of claim 1 wherein the nitrogen-containing gas is selected from the group consisting of N_2, N_2O, NH_3, and NF_3.

6. The method of claim 1 wherein the silicon-containing gas comprises TEOS, the fluorine-containing gas comprises SiF_4, and the oxygen-containing gas comprises O_2.

7. The method of claim 1 wherein the gaseous mixture further includes an inert gas.

8. The method of claim 1 wherein providing energy comprises forming a plasma from the gaseous mixture in the process chamber.

9. The method of claim 1 wherein a ratio of a flow rate of the nitrogen-containing gas into the process chamber to a total flow rate of the gaseous mixture into the process chamber is less than about 10%.

10. The method of claim 1 wherein the nitrogen-containing fluorinated silicate glass layer has a nitrogen content of less than about 5 at. %.

11. The method of claim 10 wherein the nitrogen-containing fluorinated silicate glass layer has a nitrogen content of less than about 1 at. %.

12. The method of claim 11 wherein the nitrogen-containing fluorinated silicate glass layer has a nitrogen content of less than about 0.1 at. %.

13. The method of claim 12 wherein the nitrogen-containing fluorinated silicate glass layer has a nitrogen content of about 0.03-0.08 at. %.

14. The method of claim 1 wherein the nitrogen-containing fluorinated silicate glass layer is formed over a barrier layer.

15. The method of claim 14 wherein the barrier layer is formed over a metal layer.

16. The method of claim 15 wherein the metal layer comprises copper.

17. The method of claim 14 wherein the barrier layer comprises at least one of tantalum and tantalum nitride.

18. A method of forming a layer on a substrate in a process chamber, the method comprising:

forming a fluorinated silicate glass layer over the substrate;

forming a patterned photoresist layer over the fluorinated silicate glass layer;

etching the fluorinated silicate glass layer according to the patterned photoresist layer;

removing the photoresist layer and substantially simultaneously introducing nitrogen dopants into the fluorinated silicate glass layer by subjecting the photoresist layer and the fluorinated silicate glass layer to a plasma formed from a nitrogen-containing gas.

19. The method of claim 18 wherein the nitrogen-containing gas is selected from the group consisting of N_2 and NH_3.

20. The method of claim 18 wherein the nitrogen-containing gas comprises at least one of N_2 and NH_3.

21. The method of claim 18 wherein the plasma contains no oxygen species.

22. The method of claim 18 wherein nitrogen dopants are incorporated into the fluorinated silicate glass layer in a region near a surface of the fluorinated silicate glass layer which is exposed to the plasma formed from the nitrogen-containing gas.

23. The method of claim 22 wherein the region near the surface of the fluorinated silicate glass layer has a nitrogen content of less than about 10 at. %.

24. The method of claim 23 wherein the region near the surface of the fluorinated silicate glass layer has a nitrogen content of about 1 to about 5 at. %.

25. The method of claim 18 further comprising forming a barrier layer over the nitrogen-containing fluorinated silicate glass layer.

26. The method of claim 25 wherein the barrier layer comprises at least one of tantalum and tantalum nitride.

27. The method of claim 25 further comprising forming a metal layer over the barrier layer.

28. The method of claim 27 wherein the metal layer comprises copper.

29. A substrate processing system comprising:

a housing defining a process chamber;

a substrate support configured to support a substrate during substrate processing;

a gas delivery system configured to introduce gases into the process chamber, including sources for a silicon-containing gas, a fluorine-containing gas, an oxygen-containing gas, and a nitrogen-containing gas;

a plasma generating system;

a controller for controlling the plasma generating system, the gas-delivery system, and the pressure-control system; and

a memory coupled to the controller, the memory comprising a computer-readable medium having a computer-readable program embodied therein for directing operation of the substrate processing system, the computer-readable program including

a first set of instructions to control the gas-delivery system to flow a gaseous mixture containing flows of the silicon-containing gas, the fluorine-containing gas, the nitrogen-containing gas, and the oxygen-containing gas;

a second set of instructions to control the plasma generating system to generate a plasma from the gaseous mixture; and

a third set of instructions to control the substrate processing system to deposit a nitrogen-containing fluorinated silicate glass layer onto the substrate from the plasma generated from the gaseous mixture.

30. The substrate processing system of claim 29 wherein the plasma generating system is operatively coupled to the process chamber for generating an *in situ* plasma from the gaseous mixture in the process chamber, and wherein the substrate support is configured to support the substrate in the process chamber during substrate processing.